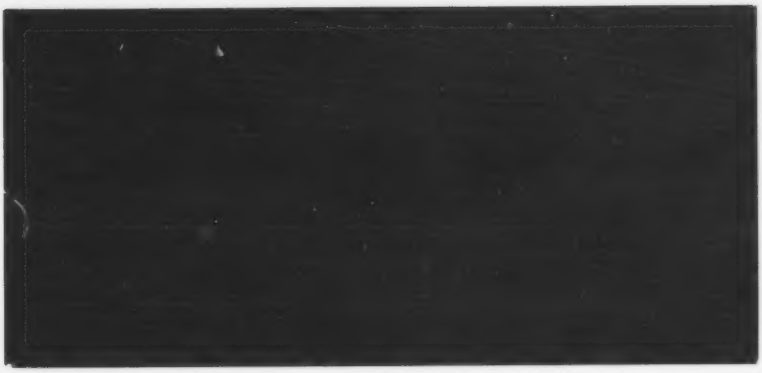
Economic Council
of Canada

Conseil économique
du Canada

Working Paper
Document de travail



Working Paper No. 20

Unemployment Disparity: An Analysis of the Impact of Economic Structure

Andrew Burns

1991

ISSN 1180-3487

Unemployment Disparity: An Analysis of the Impact of Economic Structure

The findings of this paper are the sole responsibility of the author and, as such, have not been endorsed by the Economic Council of Canada.

92-01983/

The Economic Council's Working Papers are protected by the Crown copyright and may be reasonably quoted under the terms of Canada's copyright laws. Requests for permission to reproduce or quote long excerpts should be addressed to:

Director of Publications
Economic Council of Canada
P. O. Box 527
Ottawa, Ontario
K1P 5V6

Contents

Acknowledgments vii

Foreword ix

Abstract xi

Introduction 1

Economic Structure and Regional Unemployment 2
- Economic Structure Defined 2
- Structurally Corrected Unemployment 4
- Aggregation Bias 5
- Interdependence of Structure and Probability 6

Individual Unemployment Probabilities 7
- Modelling Individual Unemployment Probabilities 7
- Outline of a Model 8
- An Econometric Model 9
- Data and Estimates 10

Economic Structure and Regional Disparity 11
- Empirical Estimates of the Structurally Corrected Unemployment Rate 15
- Comparability of Census and LFS Unemployment Rates 19

Issues of Interpretation 22
- The Nonstructural Gap 22
- Structural Unemployment 26
- Discussion of Estimates 28

Summary and Conclusion 29

Appendix A 31

Notes 35

References 37

List of Tables and Charts

Tables

1	Regression Summary Statistics, 1971, 1981, and 1986	12
2	Selected Parameter Estimates, 1971, 1981, and 1986	13
3	Compositionally Corrected Unemployment Rates, 1971	18
4	Compositionally Corrected Unemployment Rates, 1981	18
5	Structurally Corrected Unemployment Rates, 1986	19
6	Provincial Unemployment Gaps: Structural and Nonstructural Components, 1971, 1981, and 1986	20
7	Compositionally Corrected Unemployment Rates, 1971, 1981, and 1986 (LFS Basis)	22
8	Provincial Unemployment Gaps: Decomposition into Structural and Nonstructural Components (LFS Basis)	23
A-1	Labour Force Distribution by Industry, Occupation, and Region	31
A-2	Provincial Unemployment Rates, 1981	33

Charts

1	Unemployment Rate Gaps: Structural and Nonstructural Components, 1971, 1981, and 1986 (Census Basis)	21
2	Unemployment Rate Gaps: Structural and Nonstructural Components, 1971, 1981, and 1986 (LFS Basis)	24
3	Structural Unemployment: Equilibrium and Disequilibrium, 1971, 1981, and 1986	27

Acknowledgments

In preparing this paper I have received the aid and help of a number of individuals. I would like to thank many colleagues at the Council with whom I had discussions over the past year: Ross Preston, Jean-Pierre Voyer, and Richard Roy, among others. Their comments and suggestions went a long way to clarifying my paper and contributing to what is good in it. I would like to explicitly acknowledge the work of the Council's Publications Committee – and especially the referee whose comments on an earlier draft prompted me to make significant changes which I hope have improved the exposition of the paper. In addition, I would like to thank the Informatics Group for their patience while the regressions and calculations for this paper chewed up huge quantities of CPU time. I would also like to thank Mary Rowe, Pat Nevin, and Marg Willis, all of whom at one time or another lent a much appreciated hand. Responsibility for all remaining errors and omissions remains my own.

Foreword

The persistence of regional differences in unemployment rates is an enduring characteristic of the Canadian economy. Over the past 30 years, the Atlantic provinces have experienced unemployment rates that were, on average, 30 per cent higher than the national rate, while the Prairie provinces have tended to enjoy rates 30 per cent lower than the national average. These trends, coupled with marked differences in regional economic structure, have led observers to speculate that interregional disparities in unemployment rates are the result of differences in industrial structure.

The distinction between structural and nonstructural explanations for regional differences in unemployment is critical to policymakers. While high unemployment, regardless of cause, is of concern at the individual level and raises important questions of interpersonal equity, it need not be an indication of economic inefficiency. If differences in regional unemployment rates are fully explained by differences in economic structure, then they need not be symptomatic of economic inefficiency. On the other hand, if interregional unemployment differences cannot be explained by differences in economic structure, then some form of market distortion or regional aggregate-demand phenomenon may be at work, and considerable gains in economic efficiency could be realised by an appropriate policy response.

While the argument for a structural cause to unemployment disparity has always been intuitively attractive, economists have found little evidence that, in fact, structure explains much of observed interregional differences. This paper's major contribution is to extend the existing methodology by which structure is measured. Estimates based on this new methodology suggest that a significant proportion (greater than 50 per cent) of observed unemployment disparity can indeed be explained by economic structure.

The paper was prepared by Andrew Burns, an economist on the staff of the Council. It was undertaken as part of the Council's assessment of Canadian labour markets for its Twenty-Seventh Annual Review [1990], *Transitions for the 90s.*

Judith Maxwell
Chairman

READER'S NOTE

The reader should note that various conventional symbols similar to those used by Statistics Canada have been used in the tables:

.. figures not available
... figures not appropriate or not applicable
– nil or zero.

Abstract

This paper presents new estimates of the extent to which differences in economic structure explained interprovincial disparities in unemployment in each of three census years – 1971, 1981, and 1986. Estimated coefficients from a logit model of individual unemployment probability for each of the 10 provinces are used to calculate compositionally corrected unemployment rates that simulate what the unemployment rate in each province would have been, had the distribution of labour force and industry characteristics in that province been the same as in Ontario. The compositionally corrected unemployment rates indicate that when economic structure is held constant, the level of interprovincial disparity is greatly reduced. As much as 50 per cent of the difference between provincial unemployment rates in 1986 can be explained by differences in industrial structure.

Introduction

Observers of the Canadian economy have long argued that a substantial portion of interregional differences in unemployment rates is rooted in disparities in industrial structure from province to province. Thus unemployment in Newfoundland, it is claimed, is higher than in Ontario because the industries located in the former tend to be more seasonal and less stable. An individual working in Newfoundland will therefore have, all other things being equal, a greater chance of being unemployed; and the province as a whole, of having a higher unemployment rate. Despite the intuitive appeal of such arguments, economists have been singularly unsuccessful in their efforts to quantify the extent of this effect.

This paper presents estimates of the contribution of regional economic structure to unemployment disparity in Canada at three separate points in time – i.e., in June of 1971, 1981, and 1986. The estimates are an extension of the type of calculations made by Perry [1970], Hall [1970], and Summers [1986] in the United States. Structure is defined in broad terms, in this paper, to simultaneously incorporate the effects of demography, worker skills, industry, occupation, linguistic considerations, and the urban/rural structure of the economy and the labour force. Defined in this way, economic structure is shown to explain as much as 50 per cent of interprovincial gaps in unemployment rates. While the share of structure remains important, it is also shown that a recent widening of interprovincial unemployment disparities can be traced to nonstructural influences.

Unemployment rates can differ from economy to economy (province to province) for any number of reasons. Keynes [1936, p. 6] argued that, at a given point in time, there would exist unemployment of three types – involuntary, voluntary, and frictional. Economists working in the Keynesian tradition developed Keynes's original taxonomy to include structural unemployment, frictional unemployment, and cyclical unemployment. It has been widely believed that frictional and structural unemployment (the latter includes elements of frictional and involuntary unemployment) are relatively constant over time and that most of the fluctuations observed in the aggregate unemployment rate result from changes in cyclical unemployment. More recently, however, this notion of stable structural unemployment has been questioned.

Increasingly, macroeconomics is taking into consideration the interdependence of economic conditions, economic structure, and institutions. The whole discussion of hysteresis in the labour market and in exchange rate markets is a recognition of the fact that changes in economic conditions can have a permanent impact on the structure of an economy and on the way a given economic structure shapes economic aggregates. Similarly, some authors [e.g., Lilien 1982] argue that market imperfections exist which enable the impact

of an economy's structure to change as do economic conditions. This paper fits into this modern tradition by providing estimates of structural unemployment that are conditional on external economic conditions. Within this analytical framework, economic aggregates can vary, either over time or across economies, for any of three classes of reasons: 1) external economic conditions; 2) institutional factors; and 3) economic structure. These three factors together will determine the level of unemployment in any given province. For that reason, a change in any of the three factors will change both the unemployment rate in that province and *the impact that each class of factors has on the aggregate unemployment rate.*

This paper is divided into six sections: this introduction; a second section that defines what we mean by economic structure and describes how other authors have attempted to measure its importance; a third that outlines the probability model underlying our empirical results; a fourth in which are presented our estimates of the influence of economic structure on regional unemployment; a fifth, discussing these results and their interpretation; and a final section in which the results are summarized.

Economic Structure and Regional Unemployment

Economic Structure Defined

An economy is an extremely complicated organism. It consists of a vast assortment of agents – firms and individuals – who each engage in a number of activities. The interaction of these agents – the acts of production and consumption – is the subject matter of economics. The objective characteristics of the agents – the age, sex, and skills of workers; and the technology of production, resources, and industry of firms – constitute the structure of an economy (see box).

Microeconomic theory leads us to expect that similar agents in similar situations – i.e., exposed to similar incentives – will behave similarly and that agents with different characteristics will behave differently from one another. Thus large firms operate differently from small firms, and married women with small children can be expected to act differently from single men. Service-sector firms respond to market fluctuations differently from manufacturing-sector firms, and primary income earners respond differently from secondary workers. By the same token, we expect that a given industry operating under a particular set of exogenous economic conditions will behave differently under a second set of conditions.

At any point in time – that is, under any given set of exogenous circumstances – economic aggregates, such as provincial unemployment rates, can differ either because the characteristics of industry and workers differ from

Economic Structure

The Determination of Industrial and Labour Force Structure

The industrial, occupational, and demographic structure of any given economy (national or provincial) is dictated, at least in part, by the natural resources with which it is endowed. Abundant fish and distance from large markets are defining characteristics of the Newfoundland economy and imply a cost advantage in the production of fish and an important cost disadvantage in the production of bulky durables and manufactured goods destined for large mainland markets. Similarly, southern Ontario, by virtue of its proximity to major U.S. markets and industry, is well positioned to specialize in the production of manufactures and hard-to-transport durables.

At the same time, the educational, demographic, and personal characteristics of a population are also, to some extent, a function of the resource base. At any given time, the demography of a province will be dictated by cultural, historical, and economic influences on the birth, death, and migration rates of its population. Similarly, the skills of an economy's labour force reflect choices made in the past on the basis of the potential career paths available. These alternatives were a function of the industrial structure, which, in turn, was largely determined by the resource base. The industrial structure of a province and the characteristics of its labour force are, therefore, inextricably intertwined and tied to history, culture, and the natural resource base. It is not realistic to envision changes to industrial structure without contemporaneous changes to the labour force, and vice versa. That is why it is necessary to consider industrial structure and labour force composition both as having been simultaneously determined and as being interdependent.

We use the term economic structure to refer to the ensemble of individual and industrial characteristics that describe an economy and its work force. The age, sex, marital status, educational attainment, occupation, and place of residence of the work force, as well as attributes that are more strictly economic – such as the mix of industry, the density of labour markets, and the nature of jobs – constitute the economic structure of an economy. When we refer to the impact of structure on unemployment disparity, we mean the joint impact of the industrial structure of a region and the influence of the characteristics of its labour force.

province to province (differences in economic structure) or because objectively similar actors behave differently in different provinces. Regional unemployment rates can vary either because like agents behave differently or because one economy has relatively more firms or workers with high-unemployment characteristics.

Over time, variations in nonstructural factors (such as the level of aggregate demand, world prices, and the policy environment) can cause variations

in regional unemployment rates. Thus the unemployment rate of any province at any given point in time will be jointly determined by 1) that province's economic structure, 2) the particular way in which labour markets operate in the province, and 3) external economic conditions.

Structurally Corrected Unemployment

A number of papers in the 1970s and 1980s attempted to explain rising unemployment and regional disparity by changes in economic structure. Among the most notable were studies by Perry [1970], Hall [1970], and Summers [1986], who set out to calculate "structurally corrected" unemployment rates. These authors noted that the aggregate unemployment rate is simply equal to the weighted sum of subgroup unemployment rates, where the weights are provided by the shares of these subgroups in the labour force. At the regional level, the unemployment rate of province j (UR_{jt}) is simply equal to the sum of the unemployment rates (UR_{ijt}) in all subsectors, weighted by their share in the labour force (n_{ijt}/N_{jt}). Mathematically, this is expressed as

$$UR_{jt} = \sum_{0}^{I} UR_{ijt} \times \frac{n_{ijt}}{N_{jt}}. \tag{1}$$

Equation 1 has lent itself to two kinds of calculation in the literature. The first seeks to measure the extent to which intertemporal movements in the aggregate unemployment rate of a single economy can be explained by changes in its economic structure over time. The second type of calculation measures the extent to which differences in economic structure from one economy to another can explain differences in unemployment rates. The calculations presented here are of this second type. From equation 1 it should be clear that at any point in time (t), provincial unemployment rates can differ either because subsector labour-force shares differ from province to province or because subsector unemployment rates differ, or as a result of some combination of the two effects.

In order to abstract away from the impact of economic structure, one need only hold the distribution of characteristics constant across regions. Equation 2 presents the formula for a structurally corrected unemployment rate, where all provinces are assumed to have the same subsector labour-force shares as in Ontario. The structurally corrected unemployment rate indicates the unemployment rate in province j that one would expect if it had the same distribution of industries as Ontario.[1]

$$UR^{C}_{jt} = \sum_{0}^{I} UR_{ijt} \times \frac{n_{i,\,ont,\,t}}{N_{ont,\,t}}. \tag{2}$$

If differences in industrial structure were the sole explanation for differences in provincial unemployment rates, then UR^C would be equal to Ontario's unemployment rate. If they explained none of the difference, which would be the case if the distribution of industries in province j was the same as in Ontario or if all industries had the same unemployment rate, then UR^C_{jt} would be equal to UR_{jt}.

Together, equation 2 and equation 3 enable us to decompose the actual unemployment rate gap between province j and Ontario into a structural and a nonstructural component:

Total gap = structural gap + nonstructural gap

$$UR_{jt} - UR_{ont,\,t} = (UR_{jt} - UR^C_{jt}) + (UR^C_{jt} - UR_{ont,\,t}). \qquad (3)$$

Simply stated, the difference between the unemployment rate of province j and that of Ontario is equal to structural differences ($UR_{jt} - UR^C_{jt}$), the difference in unemployment rates explained by differences in provincial labour-force shares, and nonstructural reasons ($UR^C_{jt} - UR_{ont,t}$), the difference explained by differences in subsector unemployment rates.

Aggregation Bias

Although the logic underlying equation 3 is clear, in practice it has not been possible to produce accurate measures of the influence of industrial structure following the cross-tab methodology. The basic problem is that a unidimensional or even tridimensional categorization, unless extremely disaggregated, cannot possibly break down the labour force into groups sufficiently homogeneous to permit accurate estimates of the likelihood of their members being unemployed. The average unemployment rate of a particular subgroup of individuals is not an accurate measure of the unemployment probability of any particular individual in the subgroup. Its use in the calculation of structurally corrected unemployment rates can result in aggregation bias.

The problem is evident if we consider the unemployment probabilities of a worker in the service sector. Following standardized classifications, a service-sector worker could as easily be the president of a life insurance company as an usher at a movie theatre. Obviously, two such individuals have very different individual characteristics and unemployment chances. Even if we take occupation into simultaneous consideration, it is not possible to get an accurate estimate of an individual's chance of becoming unemployed. Consider a manager in the accommodation and food services sector. Such a person could as easily be the assistant manager of a McDonald's restaurant as the director

of a chain of hotels. These difficulties are not wholly academic, as they can lead to seriously biased estimates of the importance of structure. Appendix A presents a simple illustrative example.

The deeper the level of disaggregation, the more likely the estimated unemployment probabilities will be correct. Subgroup unemployment rates are, in fact, simple estimates of the expected rate of unemployment of individuals with the group's characteristics. The more disaggregated the subgroups, the more accurate the conditional expectation (probability). At the limit, we can calculate unemployment probabilities for every individual in the economy that will be conditional on all his/her characteristics and on the characteristics of the labour market in which he/she participates. That is, in fact, the methodology that we have pursued.

Interdependence of Structure and Probability

It is worth noting that the structurally corrected rate of unemployment calculated in equation 2 is not independent of economic conditions. The impact of a difference in economic structure is not independent of sectoral unemployment probabilities. Even if economic structure is held constant, its impact can vary if unemployment probabilities change. Take the case of two economies with very different economic structures but with identical unemployment rates in each subsector. It should be clear from equation 2 that the structurally corrected unemployment rate would be the same as the actual rate and from equation 3 that the *impact* of the differences in economic structure is zero.

In more realistic terms, the impact that different economic structures will have on provincial unemployment rates will depend on economic conditions. Small differences in structure can imply large impacts if unemployment rates are greatly different from one sector to another. Because the impact of structure depends on economic events, the structural gap between two provinces can change even if their economic structures do not. Take the example of a province that is relatively specialized in cyclically sensitive industries. During a recession, its unemployment rate will rise relatively more than that of other provinces. In our measure, so will its structural gap relative to those provinces. The impact of its economic structure *during* a recession is to increase its unemployment rate by a greater amount than in the other provinces. It is perfectly normal for the structural gap to be higher during economic downturns.[2] Similarly, resource-based economies will have relatively low structural unemployment during booms and relatively high structural unemployment during busts. In fact, it is entirely possible for the structure of an economy such as Alberta's to be a net asset at one point in time – during the oil boom – and a net liability at another – say, after the fall in oil prices.

This discussion serves to highlight an important theoretical and empirical fact that is often overlooked: structural unemployment is not independent of economic events. Economic structure may be more or less immutable – or at least very slow to change – but its impact on unemployment and unemployment disparity is not.

Individual Unemployment Probabilities

The rate of unemployment in a particular province or region, at any point in time, is equal to the number of individuals unemployed, divided by the number of people in the labour force. The unemployment rate in a given province is a direct function of the unemployment probabilities of the individuals who participate in its labour force. The more prone individual workers are to unemployment, the higher the aggregate unemployment rate.

Modelling Individual Unemployment Probabilities

Economic theory leads us to expect that the probability that a given individual will be unemployed at a given point in time will be a function of: 1) his/her probability of becoming unemployed at any given point in time in the past; and, 2) having become unemployed, the amount of time he/she can expect to remain so before finding a new job or leaving the labour force. Each of these probabilities depends upon the individual's labour-force attachment, the economic conditions affecting the labour market in which he/she is a member, and the overall level of activity in the economy.[3]

The expression "labour-force attachment" seeks to encompass those aspects of individual behaviour which make one more or less prone to lose one's job and, once having lost it, more or less enthusiastic in one's search activities. It is frequently argued that younger labour-force participants, having fewer responsibilities, have a lower labour-force attachment and therefore higher unemployment probabilities. Similarly, the second income earner in households is thought to be more prone to unemployment, as the opportunity cost of a partial loss in family income is less than that of a worker who is the sole or principal income earner. Whether as a result of discrimination or by virtue of their correlation with certain desirable or undesirable attributes, some characteristics (such as age, educational attainment, sex, language, or immigration status) are associated with either higher or lower unemployment probabilities.

Similarly, at a particular point in time, certain industries and occupations are more prone to unemployment than others. In the Canadian context, some industries are extremely profitable and are thus able to withstand fluctuations in market conditions, while others are more marginal and are obliged to vary

their labour demand as demand for their own product varies or as nonlabour costs fluctuate. Similarly, within industries some positions are more stable than others. Engineers and managers employed with construction firms are less likely to be unemployed than are carpenters working for the same firms. Workers in labour markets characterized by unstable or marginal firms will, *ceteris paribus*, be more prone to unemployment.

Finally, the state of the cycle, the world price of inputs and products, and climatic and resource conditions can all effect the unemployment probabilities associated with any given labour market or individual.

The interaction of an individual's personal characteristics, the characteristics of the labour market in which he/she operates, and the external environment can be represented in a simple model of individual unemployment probability. In the following discussion, we draw only the briefest outlines of such a model. More detailed theoretical discussions are available in the literature.

Outline of a Model

Denote the characteristics of the individual labour-force participant as X_i, and the characteristics of the labour market in which he/she participates – i.e., the characteristics of the firms by which he/she is employed or from which he/she seeks employment – as Y_i, and let E_t represent various factors that are exogenous to individual workers or firms, such as the state of the cycle at time T and in the past, the international terms of trade, the institutional and policy framework, cultural attitudes towards work and unemployment, and any other factor likely to impact on either the incidence or duration of unemployment.

Mathematically, the probability that an individual i will be unemployed at time T $p(u_{iT})$ can be expressed as the sum of the product of two probabilities:

$$p(u_{iT} \mid X_i, Y_i, E_T) = \int_{t=-\infty}^{T} h(u_{it} \mid X_i, Y_i, E_T) \times s(d_{it} \geq T - t \mid X_i, Y_i, E_T), \quad (4)$$

where $h(u_{it})$ is the probability of individual i becoming unemployed at time t (the unemployment hazard rate), and $s(d_{it} > T - t)$ is the probability that this individual, having become unemployed at t, would still be unemployed at T (the survivor function for those becoming unemployed at t); where all three functions are conditioned by past and present exogenous factors (E_T), the characteristics of the given individual (X_i), and the characteristics of the labour market in which he participates (Y_i).

If we wish to focus our attention on the likelihood that an individual will be unemployed at a given point in time, we can abstract away from time-varying factors because at any given T, they will be constant. The probability that a given individual with characteristics X_i, working in a particular labour market described by Y_i, at time T, will be unemployed can be expressed as:

$$p_T(u) = f_T(X_i, Y_i), \tag{5}$$

where $f_T(\ )$ is conditioned by all of the past and present values of the time-varying exogenous factors (E_T) of equation 4.

In the same way that the probability of unemployment for a given individual in a given industry can vary over time with the state of the cycle or the terms of trade, so is it possible for two individuals with identical personal and labour-market characteristics to have different unemployment probabilities if they are operating in different economies. Interprovincial differences in relative endowment of resources – and therefore in the size of available rents – as well as differences in the regulatory environment, in the state of the cycle, and in cultural attitudes towards work and unemployment can result in identical individuals who work at identical jobs having different unemployment probabilities. Equation 6 allows the probability of unemployment of an individual with given characteristics operating in a given labour market to vary from province to province (j):

$$p_{Tj}(u) = f_{Tj}(X_i, Y_i). \tag{6}$$

An Econometric Model

It is, of course, impossible to observe an individual's unemployment probability per se. As a result, even with the best data on his/her characteristics and on those of the labour markets in which he/she works, empirical modelling of an individual's unemployment probability presents special problems.

Although we cannot directly measure that probability, we can infer information about the underlying probability by looking at its realization – the individual's observed labour-force status. Specifically, assume that there exists a random threshold probability p^* such that an individual will be unemployed if his unobserved unemployment probability exceeds p^*. Let $H_T(X_i, Y_i)$ be a binary indicator function such that $H_T(X_i, Y_i)$ is equal to 1 if at time T an individual is unemployed, and 0 if employed. We can use a binary model to determine whether the unobserved unemployment probability exceeds the individual's threshold probability; in other words, we can model the probability that the individual will in fact be unemployed, as follows:

$$p_{Tj}(H(\,) = 1 \mid X_i, Y_i) = p(P^* \leq p_{Tj}(u \mid X_i, Y_i))$$
$$= F_{Tj}(X_i, Y_i), \tag{7}$$

where $F(\,)$ is some cumulative distribution function and p^* is a random threshold variable.

If we assume that $F(\,)$ is the logit distribution and that it is parametrically linear in X_i, Y_i, then

$$p_{Tj}(H(\,) = 1 \mid X_i, Y_i) = \frac{1}{1 + e^{-(\beta_{Tj} X_i + \beta_{Tj} Y_i)}}, \tag{8}$$

which is an empirically estimable relation. Equation 8 suggests that the probability of someone actually being unemployed follows a logistic distribution conditioned by the individual's characteristics (X_i) and those of the labour market in which he/she finds himself (Y_i). The use of the logistic function is common in such equations because of its computational efficiency and desirable statistical properties [Amemiya 1981].

Data and Estimates

The data sets available give us a considerable amount of detail about the characteristics of individuals, limited information about the characteristics of labour markets, and very little information about the exogenous factors. The Public User Sample Tapes (PUST) of the 1971, 1981, and 1986 censuses provide information on the age, sex, marital status, household status, educational attainment, industry of work, occupation, class of work, mobility, interprovincial migration, citizenship, minority status, size of community, labour-force status, nature of labour-force participation, number of children, size of family, and number of children under age five for a representative sample of Canadians. Each of these characteristics can be expected to have an impact on the probability that a particular individual will be unemployed at a given point in time by affecting either the duration of a spell or the likelihood of being unemployed.

The empirical model presented in equation 8 can be interpreted as stating that given the state of the world at time T, an individual's probability of becoming unemployed will be a function of two elements:

1 the individual's personal characteristics and those of the labour market in which he/she participates (the $X_i Y_i$), and

2 the manner in which these factors interact – i.e., the behaviour of labour markets (the β_Ts), which is largely determined by economic conditions.

We know that different provinces have different unemployment rates. It follows, therefore, either that the characteristics of their labour forces and industrial structures are different or that labour markets in different provinces operate differently – or some combination of the two.

Subsample sizes prohibited us from estimating equation 8 for every province. We were obliged to produce parameter estimates for five regions – the Atlantic provinces, Quebec, Ontario, the Prairie provinces, and British Columbia. Different provinces within regions were distinguished by a provincial dummy variable.

Estimation was by maximum-likelihood techniques, using LIMDEP by Greene [1988].[4] Table 1 presents some summary statistics for each of the three regressions for the years 1971, 1981, and 1986. The likelihood ratio and ρ^2 are indicators of the overall goodness of fit. The likelihood ratio is a distributed χ^2 with the indicated degrees of freedom. McFadden's ρ^2 is meant to be analogous to the standard R^2 and is bounded between 0 and 1. The percentage of unemployed correctly predicted is meant to be a rough indicator of the predictive power of the model.[5] Table 2 reports a sampling of some of the coefficient estimates for each of the three years. Most variables are categorical. The default category is indicated in the parentheses. Coefficients that are significant at the 10-per-cent level are identified by a single asterisk (*), while those significant at the 5-per-cent level are indicated by a double asterisk (**). A negative sign means that the indicated attribute reduced the probability of unemployment, while a positive sign indicates that the attribute increased that probability. Although the values of the estimated coefficients cannot be construed as marginal probabilities, they are monotonic transformations of the actual marginal probabilities. Larger values therefore imply larger effects. A complete record of estimates and asymptotic *t*-scores is available from the author upon request.

Viewed within the context of limited dependent-variable analysis, the results are satisfactory. In no case must a model be rejected because of statistical insignificance. The fact that the 1981 census was taken on the eve of what was perhaps the deepest recession since the Second World War may explain why the estimates based on these data provide a somewhat less powerful predictor of an individual's labour-force status. The forces that provoked the recession of 1981-82 were undoubtedly already at work and may well have had an impact on the precision of parameter estimates.

Economic Structure and Regional Disparity

Given the distributional assumptions implicit in our choice of the logit probability function and the adequacy of the regressors used, the 15 sets of estimated parameters are unbiased estimates of the actual parameters. We can

Table 1

Regression Summary Statistics, 1971, 1981, and 1986

	Atlantic provinces	Quebec	Ontario	Prairie provinces	British Columbia
1971					
Log likelihood at maximum	−1,404.4	−4,922.8	−6,203.8	−2,423.9	−2,039.4
Likelihood ratio	1,140.8	4,873.8	4,551.4	1,942.2	1,492.2
Mcfadden's ρ^2	28.8	33.1	26.8	28.6	26.8
Per cent *U* correct	25.4	34.3	25.3	23.7	25.6
Degrees of freedom	64	64	64	64	64
N	6,719	22,270	34,167	14,971	9,248
1981					
Log likelihood at maximum	−3,487.3	−8,969.5	−9,994.1	−3,986.6	−3,366.1
Likelihood ratio	1,472.2	2,813.0	2,945.8	2,279.2	1,479.8
Mcfadden's ρ^2	17.4	13.5	12.8	22.2	18.0
Per cent *U* correct	21.9	28.0	19.8	14.3	15.5
Degrees of freedom	72	72	72	72	72
N	10,196	31,449	45,636	21,959	13,986
1986					
Log likelihood at maximum	−4,065.5	−9,708.3	−11,463.0	−6,245.4	−4,820.5
Likelihood ratio	2,493.0	7,329.4	5,252.0	3,229.0	3,220.8
Mcfadden's ρ^2	23.4	27.4	18.6	20.5	25.1
Per cent *U* correct	28.1	30.4	24.5	17.2	27.4
Degrees of freedom	63	63	64	64	64
N	10,749	32,236	49,604	23,504	15,385

use them to examine the role of economic structure in determining provincial unemployment rates. The parameters in equation 8 enable us to calculate (analytically) the expected unemployment rate for each class of workers endowed with the characteristics of each worker in our sample. The estimation technique ensures that the weighted sum of these expected unemployment rates will equal the actual unemployment rate in each province, which enables us to write:

$$UR_{jt} = \sum_{i=0}^{N_{jt}} \frac{e^{\beta_{jt}X_{it}}}{1 + e^{\beta_{jt}X_{it}}} \times \frac{1}{N_{jt}} \quad \forall j$$

$$= \sum_{i=0}^{N_{jt}} E(UR_{ijt} \mid X_{it}, \beta_{jt}) \times \frac{1}{N_{jt}} \quad \forall j, \tag{9}$$

Table 2

Selected Parameter Estimates, 1971, 1981, and 1986

	Atlantic provinces	Quebec	Ontario	Prairie provinces	British Columbia
Newfoundland					
1971	–3.618**	...	...	...	...
1981	–1.209**	...	...	...	...
1986	–0.936**	...	...	...	...
Nova Scotia					
1971	–3.853**	...	...	...	...
1981	–1.412**	...	...	...	...
1986	–1.690**	...	...	...	...
New Brunswick					
1971	–3.854**	...	...	...	...
1981	–1.381**	...	...	...	...
1986	–1.475**	...	...	...	...
Quebec					
1971	...	–3.278**	...	...	...
1981	...	–0.895**	...	...	...
1986	...	–0.646**	...	...	...
Ontario					
1971	...	...	–2.609**	...	...
1981	...	...	–1.221**	...	...
1986	...	...	–0.527**	...	...
Manitoba					
1971	...	...	...	–2.928**	...
1981	...	...	...	–2.613**	...
1986	...	...	...	–1.578**	...
Saskatchewan					
1971	...	...	...	–3.007**	...
1981	...	...	...	–2.921**	...
1986	...	...	...	–1.536**	...
Alberta					
1971	...	...	...	–2.871**	...
1981	...	...	...	–3.098**	...
1986	...	...	...	–1.531**	...
British Columbia					
1971	...	...	...	...	–3.151**
1981	...	...	...	...	–2.131**
1986	...	...	...	...	–1.548**

Table 2 (cont'd.)

	Atlantic provinces	Quebec	Ontario	Prairie provinces	British Columbia
Sex (male)					
1971	–0.465**	–0.299**	–0.120	–0.088	–0.059
1981	0.058	–0.035	0.104**	0.171*	0.354**
1986	0.124	0.104*	0.029	–0.071	–0.028
Babies					
1971	–0.127**	–0.076**	–0.027	–0.082*	0.076
1981	0.049	0.051**	–0.017	–0.025	0.037
1986	. . .	. . .	. . .	. . .	. . .
Age					
1971	–0.033	–0.050**	–0.077**	–0.084**	–0.014
1981	–0.030	–0.045**	–0.044**	–0.009	–0.015
1986	–0.033*	–0.046**	–0.079**	–0.033**	–0.024*
Age^2 (× 0.0001)					
1971	3.6	6.2**	10.0**	10.0**	1.6
1981	0.2	0.4**	0.6	0.6	0.6
1986	1.5	3.7**	8.2**	2.6	2.5
French (English)					
1971	–0.177	0.111	0.291	0.264	–17.938
1981	0.317*	0.136	0.189	0.876	–15.727
1986	0.051	–0.133	0.436	0.571	–15.433
Bilingual (English)					
1971	0.111	0.017	0.175**	0.244*	0.352**
1981	0.056	–0.013	0.107	0.122	0.020
1986	0.130	–0.143	0.089	–0.154	0.037
Elementary (high school)					
1971	0.205	0.134*	0.234**	0.397**	0.317**
1981	0.336**	0.224**	0.201**	0.424**	0.187
1986	0.518**	0.403**	0.106	0.190**	0.411**
University (high school)					
1971	–0.195	–0.155	–0.067	–0.117	–0.381
1981	–0.184	–0.345**	–0.109	–0.431**	–0.462**
1986	–0.612**	–0.258**	0.039	–0.402**	–0.238
Post-graduate (high school)					
1971	–0.961	–0.310	0.130	–0.135	–0.270
1981	–0.397	–1.228**	–0.673**	–0.430	–0.210
1986	–0.547	–0.547**	0.152	–0.517*	–0.101

Table 2 (concl'd.)

	Atlantic provinces	Quebec	Ontario	Prairie provinces	British Columbia
Full-time (self-employed)					
1971	0.491*	0.553**	0.344**	0.623**	0.113
1981	0.217	0.293**	0.215**	0.271*	0.094
1986	0.594**	0.015	–0.022	0.162	0.071
Part-time (self-employed)					
1971	0.530*	0.613**	0.285*	0.505**	0.495**
1981	0.320**	0.399**	0.204**	0.219	0.221
1986	0.618**	0.295**	–0.023	0.312**	0.253**
Large city (small urban), 1971	–0.138	–0.128	–0.234**	–0.196*	–0.237**
Large city (small urban), 1981	–0.461**	–0.291**	–0.315**	0.012	–0.372**
Large city (not large), 1986	. . .	–0.292**	–0.349**	0.272**	–0.221**

*Indicates an estimated coefficient significant at the 10-per-cent level.
**Indicates an estimated coefficient significant at the 5-per-cent level.

where i indexes individuals and N_{jt} is equal to the labour force in province j at time t, and where the parameters in the model (β_{jt}) depend upon the region and the year for which they are estimated. For simplicity's sake, from this point on we suppress the Ys from our notation, using X to represent both individual and industrial characteristics. Equation 9 is similar in form to equation 1, used by other researchers, except that the number of distinct classes of workers incorporated in the present analysis far exceeds that in previous work, and the methodology used in estimating the expected rate of unemployment for classes of workers is different.

Empirical Estimates of the Structurally Corrected Unemployment Rate

As was the case with the cross-tab methodology, examination of equation 9 makes it clear that at a given point in time, the unemployment rate in any province can vary for one of two reasons: 1) because of differences in economic structure (the Xs); or 2) because of differences in the way that individual and labour-market characteristics interact to determine probabilities (the βs). In any given year, the unemployment rate in one province differs

from those in other provinces because of differences in industrial structure and because labour markets in different provinces operate differently.

If we hold the distribution of individual and labour-market characteristics constant across provinces, we can calculate structurally corrected rates of unemployment in much the same way as in equations 2 and 3. The process, however, presents two difficulties. The first derives from the nonlinear nature of the logit function, and the second from the fact that many of our independent variables are discrete and therefore not differentiable. These two difficulties are, however, susceptible to analysis.

Assume two individuals with characteristics X_1 and X_2. Assume that individual 1 lives in province a and individual 2 lives in province b. Let $F(\,)$ represent the logit function; then the unemployment probabilities of 1 and 2, at time t, are given by $p_1(u)$ and $p_2(u)$:

$$p_{1t}(u) = F(\beta_{ta}, X_1),$$

$$p_{2t}(u) = F(\beta_{tb}, X_2). \tag{10}$$

The difference in their probabilities is:

$$\Delta p_t(u) = F(\beta_{ta}, X_1) - F(\beta_{tb}, X_2), \tag{11}$$

which cannot be further reduced because of non-linearities and the lack of differentiability. We can, however, write:

$$\Delta p_t(u) \,|_{\beta_{ta}} = F(\beta_{ta}, X_1) - F(\beta_{ta}, X_2),$$

$$\Delta p_t(u) \,|_{\beta_{tb}} = F(\beta_{tb}, X_1) - F(\beta_{tb}, X_2), \tag{12}$$

where the first expression $\Delta p(u) \mid \beta_{ta}$ measures the amount by which the unemployment probability of an individual with personal and labour-market characteristics X_1 living in province a would exceed the unemployment probability of an individual with characteristics X_2 living in the same province. The second expression $\Delta p(u) \mid \beta_{tb}$ provides the same information for individuals living in province b. If we were to ask the more general question – i.e., what impact do the differences in characteristics between individuals in provinces a and b have on their unemployment probability? – we would be forced to answer that it depends upon which province they live in.

In our analysis, we wish to determine the cumulative effect of the differences in characteristics of all individuals living in provinces a and b – in other words, the effect of the economic structure of the two provinces. The true impact of economic structure on provincial unemployment rates will lie

somewhere between the estimate based on the postulate that markets operate as in province *a* and that which assumes they behave as in province *b*.

In the aggregate, the weighted sum of these differences provides two estimates of the effect that economic structure has on provincial unemployment rates. Equation 13 follows from equation 9 and shows the expected unemployment rate in all provinces under the assumption that they enjoyed the same economic structure as Ontario but that labour markets continued to operate in each province as before (SUR_{ija}). It also shows the rate of unemployment that could be expected in Ontario, were that province's economic structure to be the same as in the other provinces while its labour-market behaviour remained the same (SUR_{ijb}). Thus equation 13 is directly analogous to equation 2.

$$SUR_{jia} = \sum_{i=0}^{N_{ont}} \frac{e^{\beta_{ja} X_{ont,i}}}{1 + e^{\beta_{ja} X_{ont,i}}} \times \frac{1}{N_{ont,i}} \quad \forall\, j \mid j \neq ont,$$

$$SUR_{jib} = \sum_{i=0}^{N_j} \frac{e^{\beta_{ont,i} X_{ji}}}{1 + e^{\beta_{ont,i} X_{ji}}} \times \frac{1}{N_{ji}} \quad \forall\, j \mid j \neq ont. \tag{13}$$

The two simulated unemployment rates each provide an estimate of the unemployment rate that would obtain in province *j* if the distribution of individual and firm characteristics were the same as in Ontario. A priori, both simulations control for the influence of structure equally well. The true influence of structure likely lies somewhere between the two estimates. The closer the initial unemployment rates, the more accurate the estimate. As we have no prior information as to which estimate is closer to the actual rate, we use the average estimate.

The compositionally corrected unemployment rate is the rate of unemployment that would be observed if labour markets continued to operate as they do now but all compositional influences were controlled for. If labour markets in all provinces behaved identically, then all compositionally corrected unemployment rates would be identical and equal to the sample unemployment rate in Ontario. The extent to which the compositionally corrected unemployment rates differ from the rate actually observed for Ontario indicates the extent to which nonstructural influences are the cause of regional unemployment disparity.

The estimates of the structurally corrected unemployment rate and their average are reported in Tables 3 and 4. Table 5 breaks down the gap in unemployment rates between each province and Ontario into the components associated with structural factors [measured as $UR_{Tj} - (SUR_{Tja} + SUR_{Tjb})/2$]

Table 3

Compositionally Corrected Unemployment Rates, 1971

	Actual	$SUR_{71ja} = F(\beta_{71j}X_{ont})$	$SUR_{71jb} = F(\beta_{71ont}X_j)$	Average
Newfoundland	10.12	10.05	8.02	9.04
Prince Edward Island	..	..	..	..
Nova Scotia	8.23	8.59	7.17	7.88
New Brunswick	8.18	8.58	7.15	7.87
Quebec	10.25	8.62	9.14	8.88
Ontario	6.79	6.79	6.79	6.79
Manitoba	6.13	6.80	5.78	6.29
Saskatchewan	5.00	6.45	5.07	5.76
Alberta	6.47	7.07	5.96	6.52
British Columbia	8.94	7.86	7.57	7.72

Table 4

Compositionally Corrected Unemployment Rates, 1981

	Actual	$SUR_{81ja} = F(\beta_{81j}X_{ont})$	$SUR_{81jb} = F(\beta_{81ont}X_j)$	Average
Newfoundland	20.22	13.83	11.45	12.64
Prince Edward Island	..	..	..	..
Nova Scotia	13.72	12.02	9.36	10.69
New Brunswick	17.92	12.28	11.65	11.97
Quebec	13.58	11.73	10.64	11.19
Ontario	8.31	8.31	8.31	8.31
Manitoba	7.98	8.57	7.50	8.04
Saskatchewan	6.11	6.93	8.31	7.62
Alberta	5.36	6.16	7.54	6.85
British Columbia	9.01	8.54	8.41	8.48

and with nonstructural influences $[(SUR_{Tja} + SUR_{Tjb})/2) - UR_{Tont}]$. The information in Table 6 is reproduced in graphical form in Chart 1.

It should be clear from equation set 13 that the measures of structural unemployment are conditional on the estimated β_{jt}s, which are in turn determined by the particular economic conditions obtaining at time t. As a consequence, our estimates of structural unemployment and structurally based disparity are conditional on the external economic factors that hold sway at time t – e.g., the state of the business cycle, world prices for Canadian exports and imports, government policies, and cultural attitudes to work.

Table 5

Structurally Corrected Unemployment Rates, 1986

	Actual	$SUR_{86ja} = F(\beta_{86j}X_{oni})$	$SUR_{86jb} = F(\beta_{86oni}X_j)$	Average
Newfoundland	29.46	21.51	13.31	17.41
Prince Edward Island	17.85	13.72	11.28	12.50
Nova Scotia	15.33	12.89	10.96	11.93
New Brunswick	19.70	15.41	12.49	13.95
Quebec	14.55	13.64	12.48	13.06
Ontario	8.21	8.21	8.21	8.21
Manitoba	9.38	8.87	8.69	8.78
Saskatchewan	9.52	9.31	8.73	9.02
Alberta	11.25	10.77	8.30	9.54
British Columbia	14.67	11.77	10.71	11.24

Comparability of Census and LFS Unemployment Rates

The reader familiar with provincial unemployment statistics will be quick to notice that the unemployment rates reported here for the provinces do not correspond exactly to those reported by Statistics Canada. That is especially so for the two later years – 1981 and 1986. The source of deviation is two-fold.

The first source lies in the different ways in which labour-force status information is collected in the census and in the Labour Force Survey (LFS). The census data is based on individual's own one-time response to written questions designed to ascertain labour-force status. Unfamiliarity with the questions and lack of interest are important sources of potential error. In the Labour Force Survey, similar questions are repeatedly asked by trained interviewers over a period of six months. As a result, respondents are less likely to misunderstand questions and interviewers are less likely to be the source of erroneous reporting and of any consequent misclassification.

The second source of discrepancy derives from the fact that the Labour Force Survey uses the 1981 definition of unemployment, whereas in the present study we use the 1971 definition for all three years reported on, in order to facilitate intertemporal comparisons.

Table 7 shows actual unemployment rates and corrected rates that are consistent with the LFS rates recorded at the time each census was taken. Table 8 and Chart 2 show the gaps in provincial unemployment rates (relative to Ontario's), broken down into their structural and nonstructural components on an LFS basis. The census data are rendered LFS-compatible in the

Table 6

Provincial Unemployment Gaps: Structural and Nonstructural Components, 1971, 1981, and 1986

	Actual gap	Structural component	Non-structural component	Proportion of total due to structure
				(Per cent)
1971				
Newfoundland	3.33	1.08	2.25	32.43
Nova Scotia	1.44	0.35	1.09	24.31
New Brunswick	1.39	0.31	1.08	22.30
Quebec	3.46	1.37	2.09	39.60
Manitoba	–0.66	–0.16	–0.50	24.24
Saskatchewan	–1.79	–0.76	–1.03	42.46
Alberta	–0.32	–0.05	–0.27	15.63
British Columbia	2.15	1.22	0.93	56.74
1981				
Newfoundland	11.91	7.58	4.33	63.64
Nova Scotia	5.41	3.03	2.38	56.01
New Brunswick	9.61	5.95	3.66	61.91
Quebec	5.27	2.39	2.88	45.35
Manitoba	–0.33	–0.06	–0.27	18.18
Saskatchewan	–2.20	–1.51	–0.69	68.64
Alberta	–2.95	–1.49	–1.46	50.51
British Columbia	0.70	0.53	0.17	75.71
1986				
Newfoundland	21.25	12.05	9.20	56.71
Prince Edward Island	9.64	5.35	4.29	55.50
Nova Scotia	7.12	3.40	3.72	55.50
New Brunswick	11.49	5.75	5.74	50.04
Quebec	6.34	1.49	4.85	23.50
Manitoba	1.17	0.60	0.57	51.28
Saskatchewan	1.31	0.50	0.81	38.17
Alberta	3.04	1.71	1.33	56.25
British Columbia	6.46	3.43	3.03	53.10

following manner: the structural unemployment rates are inflated or deflated by the ratio of the LFS unemployment rate divided by the sample census unemployment rate for the year and province in question. The overall gap for each province is then calculated as the difference between the LFS unemployment rate for that province and Ontario's. The structural gaps are calculated as the difference between the provincial LFS unemployment rate and the LFS-adjusted, structurally corrected unemployment rate. Finally, the

Chart 1

Unemployment Rate Gaps: Structural and Nonstructural Components,[1] 1971, 1981, and 1986 (Census Basis)

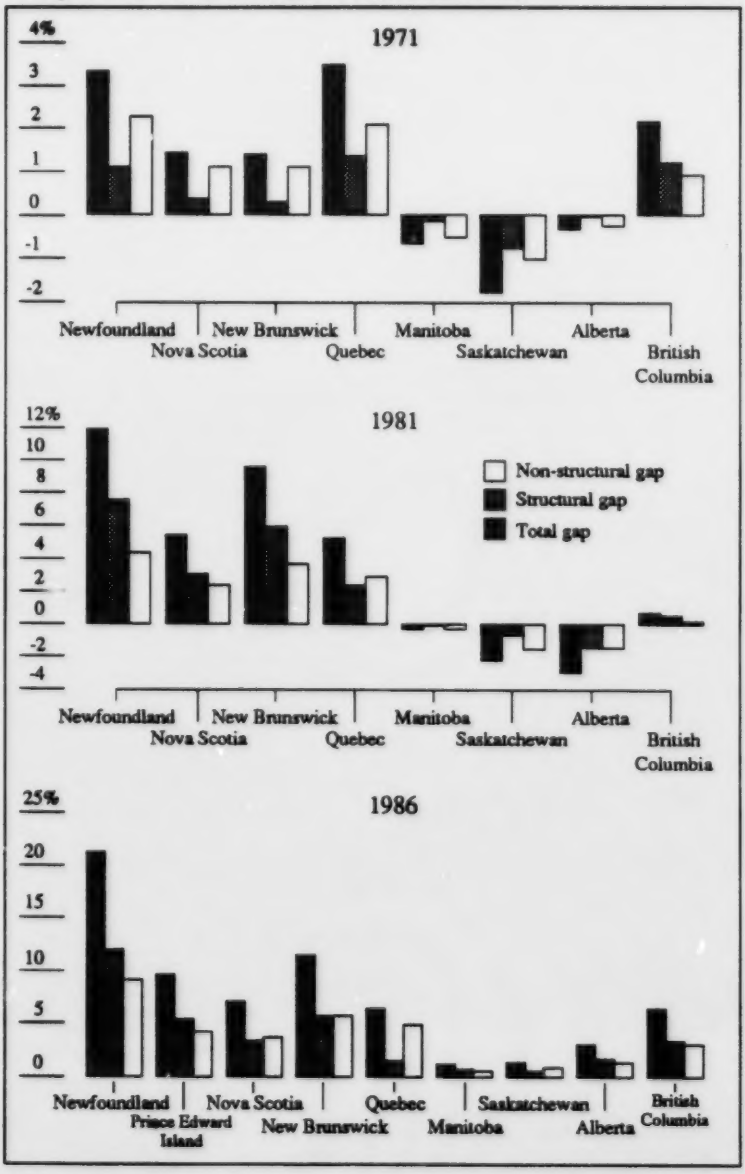


Table 7

Compositionally Corrected Unemployment Rates, 1971, 1981, and 1986 (LFS Basis)

	1971		1981		1986	
	Actual	Corrected	Actual	Corrected	Actual	Corrected
Newfoundland	6.5	5.81	12.4	7.75	17.5	10.34
Prince Edward Island	..	..	8.0	..	10.4	7.28
Nova Scotia	6.0	5.74	8.8	6.86	12.0	9.34
New Brunswick	5.8	5.58	10.6	7.08	14.4	10.02
Quebec	7.7	6.67	9.8	8.08	10.1	9.07
Ontario	5.3	5.30	6.5	6.50	7.0	7.00
Manitoba	5.3	5.44	4.9	4.94	6.4	5.99
Saskatchewan	2.2	2.53	3.6	4.49	6.9	6.54
Alberta	4.5	4.53	2.9	3.71	10.1	8.56
British Columbia	7.4	6.39	5.5	5.18	11.3	8.66

nonstructural gaps are calculated as the difference between Ontario's LFS unemployment rate and the LFS-adjusted, structurally corrected unemployment rates.

The proportional sizes of the gaps calculated in this way and on the census basis are not the same because we scaled the corrected unemployment rate, not the gaps. Because the scaling factor differs from province to province, the unemployment rate gaps can be, and are, different in both absolute and relative terms.

Issues of Interpretation

The significance of these estimates lies in their quantification of the impact of different economic structures on provincial unemployment rates at specific points in time. The results indicate the extent to which observed disparities were a function of differences in economic structure. The remaining gaps derive from differences in the estimated coefficients from region to region.

The Nonstructural Gap

In a general-equilibrium model with perfect competition within industries and across regions, the probability of unemployment of any given industrial sector should be the same, regardless of the province in which it is found.

Table 8

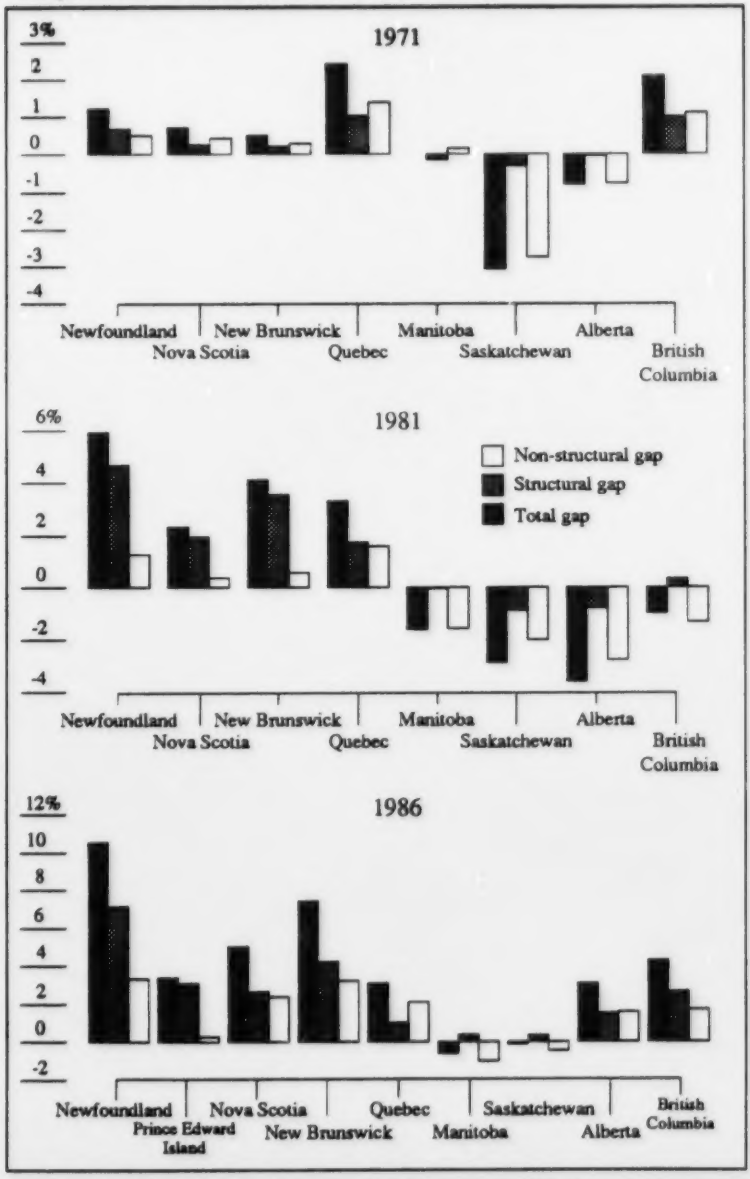
Provincial Unemployment Gaps: Decomposition into Structural and Nonstructural Components (LFS Basis)

	Actual gap	Structural component	Nonstructural component
1971			
Newfoundland	1.20	0.69	0.51
Nova Scotia	0.70	0.26	0.44
New Brunswick	0.50	0.22	0.28
Quebec	2.40	1.03	1.37
Manitoba	0.00	–0.14	0.14
Saskatchewan	–3.10	–0.33	–2.77
Alberta	–0.80	–0.03	–0.77
British Columbia	2.10	1.01	1.09
1981			
Newfoundland	5.90	4.65	1.25
Nova Scotia	2.30	1.94	0.36
New Brunswick	4.10	3.52	0.58
Quebec	3.30	1.72	1.58
Manitoba	–1.60	–0.04	–1.56
Saskatchewan	–2.90	–0.89	–2.01
Alberta	–3.60	–0.81	–2.79
British Columbia	–1.00	0.32	–1.32
1986			
Newfoundland	10.50	7.16	3.34
Prince Edward Island	3.40	3.12	0.28
Nova Scotia	5.00	2.66	2.34
New Brunswick	7.40	4.20	3.20
Quebec	3.10	1.03	2.07
Manitoba	–0.60	0.41	–1.01
Saskatchewan	–0.10	0.36	–0.46
Alberta	3.10	1.54	1.56
British Columbia	4.30	2.64	1.66

Empirically, this implies that in equation 9, the β_7s should be the same across provinces ($\beta_{ij} = \beta_{ik} \; \forall \; k, j \; \varepsilon$ provinces). To a large extent, the requirements of competition theory are satisfied. Labour in Canada is quite mobile, as approximately 1 per cent of the adult population changes provinces of residence every year. Capital, at least in its more liquid forms, is extremely mobile, and technology is widely available and largely homogeneous. Yet estimated coefficients do differ across regions. Our statistical analysis cannot reveal why behaviour differs from province to province – only that it does. We can, however, offer some informed speculation as to why the estimated βs differ.

Chart 2

Unemployment Rate Gaps: Structural and Nonstructural Components,[1] 1971, 1981, and 1986 (LFS Basis)



One explanation suggests that our measure of economic structure remains insufficiently detailed. It may be that even at the lower levels of disaggregation used in this study, there remain significant interprovincial differences in the composition of subgroups and that the differences in estimated βs continue to reflect aggregation bias.[6]

If indeed aggregation bias remains a quantitatively important problem, then our estimates will tend to understate the importance of economic structure in explaining interprovincial disparities in unemployment rates. If, however, the remaining aggregation bias plays only a quantitatively small role, then differences in the estimated βs reflect *real* differences in the way labour markets operate in different provinces.

Two categories of factors are potential explanations for real differences. The first falls under the general rubric of institutions. One can readily think of factors that are regionally specific and are likely to have an impact on the operation of labour markets; differences in provincial government policies, for example, may have an effect on incentives or on the operation of labour markets. (Such policies might include differences in provincial minimum-wage legislation, industrial subsidies, and/or labour-relations regulations.) Similarly, certain federal policies have a regional component that varies from province to province. The greater generosity of the unemployment insurance system in high-unemployment areas has frequently been cited as a potential explanation of those high levels. By the same token, region-specific cultural attitudes towards work and unemployment can affect labour supply and unemployment probabilities. Wage spillover from high- to low-productivity regions has been cited [see Drewes 1987; Burns 1990] as a cause of unemployment in the Atlantic provinces and would be reflected in different estimated coefficients for that region.

The second set of factors that serve to explain real differences in estimated βs lies somewhere between aggregation bias and institutional explanations. Geographic location (proximity to markets and/or sources of supply), the relative richness of resources (defined broadly), regional climatic conditions, and the state of the regional (as distinct from the national) business cycle tend to cause variations in the conditions governing labour markets in different regions in subtly different ways. They constitute external economic factors that differ from province to province and that can make a given economic structure more or less unemployment-prone.

Few would deny that at least some of southern Ontario's economic success is attributable to its proximity to important U.S. industrial and population centres. Conversely, the provinces at the western and eastern ends of the country face a distinct cost disadvantage because of their remoteness with respect to these same centres. Transportation costs, both in the absolute accounting sense

and in the less easily quantified spatial and cultural sense, constitute real barriers to trade and impede regional competitiveness. Similarly, the unemployment probabilities associated with the agricultural industry in a drought-stricken region will be very different from those associated with the same industry in regions not affected by drought. The same holds true for the probabilities associated with firms in areas where significant Ricardian rents accrue, compared with firms in the same industry but located in low-rent regions. The probability of unemployment of a miner working in a marginal gold mine in Newfoundland and that of an identical worker working in a very productive mine in Ontario are unlikely to be the same. In this analysis, such differences, which are in fact structural, will be reflected in the βs, not in the structure.[7]

There is no way to determine the relative importance of these three groups of factors. All of them undoubtedly play some role. Of the three, two (aggregation bias and the factors that make industries different from province to province) constitute measurement errors. Both of these influences tend to cause us to underestimate differences in regional structure and therefore the influence of structure in explaining unemployment. As a result, we can regard the estimates of structural unemployment reported here as lower bounds.

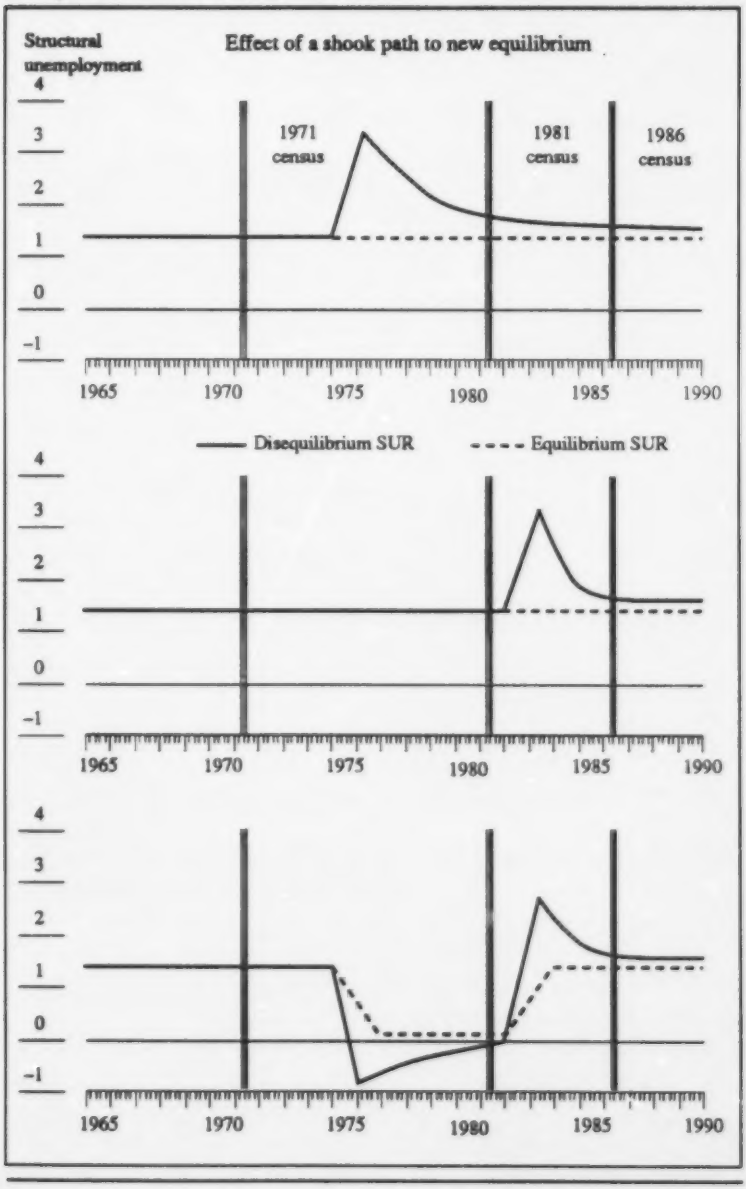
Structural Unemployment

We have emphasized at several points that the impact of economic structure and size of the structural gap are not independent of economic conditions. That naturally raises the question whether the estimates presented here and the progressive increase in the structural component reflect anomalies in the economic environment at the time when the measures were taken or whether they reflect fundamental developments. The following discussion seeks to illuminate how we might expect the dynamics of structural unemployment to react to various kinds of shocks.

Chart 3 illustrates how the level of structural unemployment might react in response to an external shock that could be on either the demand or the supply side, or could even be of a political or cultural nature. The first panel shows the dynamic path to equilibrium of an economy hit by a shock in 1976; the second, the path of an economy shocked in 1983; and the third shows the path of an economy hit by two shocks – a positive shock in 1976 and a negative shock in 1982. We assume in each case that the shock initially causes unemployment probabilities to overshoot their new equilibrium values. The new equilibrium level of structural unemployment is the same as the initial level in panels 1 and 3, while panel 2 illustrates the case where the new equilibrium is higher than the original. In all three cases, the level of structural unemployment reaches its highest point immediately after the shock and falls as the economy approaches its new equilibrium level.

Chart 3

Structural Unemployment: Equilibrium and Disequilibrium, 1971, 1981, and 1986



The implications and interpretation of a given measure of an economy's structural gap will depend crucially upon whether the measure was taken shortly after a shock – and thus is dominated by disequilibrium effects – or whether it was taken after a period of relative stability, in which case it more accurately reflects the equilibrium structural gap of the economy. In panel 1 of Chart 3, the measures taken in 1971 and 1986 are more or less good indicators of that economy's equilibrium structural gap, whereas in panel 2 the measure taken in 1986 is more or less dominated by disequilibrium effects.

Our evidence does not enable us to differentiate between the equilibrium and disequilibrium components of structural unemployment. Nor does it enable us to comment on the relative speed at which various economies have adjusted. However, examination of the changes in structural unemployment over time, coupled with additional knowledge about the nature and timing of the shocks to which different provinces have been subjected, enables us to speculate about the relative importance of equilibrium and disequilibrium effects.

Discussion of Estimates

There is reason to believe that the fall in structural unemployment in Quebec between 1981 and 1986 reflects an effect similar to that illustrated in the first panel of Chart 3. Together, the oil crises, reduced tariffs, increased foreign competition, and political turmoil of the 1970s constituted a tremendous shock in the Quebec economy and induced important changes in its structure. By 1986, the Quebec economy had already undergone significant transformation. Old industries (such as textiles, clothing, and oil refining) had been replaced or transformed into new competitive concerns. At the same time, former reliance on external sources for entrepreneurial impetus had been replaced by the development of a domestic entrepreneurial elite and of various programs, such as the Quebec Stock Savings Plan, that encouraged the development of a domestic stock of venture capital.

The experience of British Columbia is broadly reflected in the second panel. British Columbia enjoyed relatively trouble-free passage through the 1970s, and it was not until after the onset of the recession of 1981-82, in response to high interest rates and declining prices for its major exports, that industry in the province began a major restructuring. Indications are that as of 1986, that restructuring had yet to be completed; as a result, we expect that a considerable proportion of the structural unemployment reported in Table 6 represents disequilibrium structural unemployment.

The third panel reflects the pattern that might have obtained in Alberta. The initial effect of the oil shocks was to cause the Albertan economy to boom. Both the equilibrium and disequilibrium structural unemployment rates likely fell as factors were channelled into the oil sector. The decline in oil prices,

coupled with the recession of 1981-82, reversed the process; that development helps to explain the dramatic rise in structural unemployment that had occurred in that province by 1986, with a considerable amount of it falling under the disequilibrium-unemployment category.

The persistently high and rising levels of structural unemployment in the Atlantic provinces suggest a serious adjustment problem. In 1971, the unemployment gaps with Ontario were relatively small. By 1981, however, structural unemployment was much higher in all of the Atlantic provinces, suggesting that the changes in the world and Canadian economies during the intervening decade had disproportionately injured this region. During the recovery, the problem actually became worse, except in Nova Scotia. This suggests that the economic structure in these provinces has failed to adjust.

The two Prairie provinces present a relatively stable time profile. In both 1971 and 1981, their unemployment rates were marginally lower than Ontario's, with differences in economic structure explaining about half of the difference. In 1986, the gap and the amount explained by structure remained approximately the same, although the direction had reversed. It is impossible to say whether this was a function of favourable conditions in Ontario rather than of an unfavourable shock in the Prairies.

Summary and Conclusion

Our data set is not sufficiently refined to enable us to distinguish between equilibrium and disequilibrium effects, between spurious variations in βs (aggregation effects) and the effects resulting from regional economic realities (geographic effects). It is likely that in some provinces, residual aggregation bias causes the estimate of the compositionally corrected unemployment gap to be too large. Conversely, in others it may cause the estimate to be too low. Nonetheless, the gap serves as an indication of the degree to which regional unemployment rates might be amenable to policies directed at changing regional unemployment probabilities, as opposed to policies aimed at changing the industrial structure of regional economies. Where the gap is small, our analysis suggests that relatively little effort should be expended. Where the gap remains large, we have an indication of the extent to which unemployment rates could be reduced by changes in the way that provincial labour markets operate.

Obviously, these gaps constitute approximate measures. They are indicative of the possibilities for disparity reduction. A much more detailed institutional analysis would have to be conducted in order to determine the extent to which these reductions could be achieved, the extent to which behavioural factors are amenable to policy, and what policies would be the most effective.

As is often the case in empirical work, difficulties with data have limited the scope of this paper. The extent to which intertemporal measures of the impact of changes in economic structure based on aggregate time-series data are subject to underestimation caused by aggregation bias is a matter that remains undetermined.

Our present results suggest that there may have been a change in the way that labour markets operate. They are, however, only suggestive. Changes in the way that certain categories of economic structure have been defined from year to year prevent us from being able to hold the structure of a province constant in order to isolate the influence of changes in structure on the level of unemployment from one year to another. Greater consistency in the reporting (classification) of census data from year to year, as well as more frequent sampling, would make such a calculation possible.

The question is critical. As it stands, calculations based on aggregate time-series data suggest very strongly that intertemporal changes in economic structure have had little impact on the evolution of unemployment. The implication is that policy should focus less on the type of labour markets that have evolved and more on how their operation has changed over time. If, however – as our disaggregated interprovincial gap measures seem to suggest – at least some of the evolution of provincial unemployment rates can be explained by changes in provincial economic structure, then very different policies may be called for.

Estimates of structurally corrected unemployment rates for the 10 provinces of Canada have been presented here. They suggest that as much as 50 per cent of the difference between Ontario's rate and those of the other provinces can be explained by economic structure. The estimates follow a methodology that is analogous to that pursued by U.S. authors in measuring the influence of structure in the United States. It differs from those works by using an individual-unemployment-probability model to estimate conditional unemployment probabilities instead of cross-tabulations, as have previous studies. This innovation permits a greatly expanded and disaggregated definition of economic structure. By expanding the definition of structure, the estimates avoid problems that may have caused previous estimates to underestimate the impact of structure (see Appendix A).

Appendix A

Table A-1 assumes two regions (1 and 2), each with two industries (*a* and *b*) and two occupations (*x* and *y*). The table has been constructed so that each industry in each region has the same labour force and the unemployment rate in each industry/occupation pair is the same between regions. The only difference between the two regions is that region 2 has proportionately more workers in occupation *y*, industry *b* than does region 1. The third panel of the table shows the industry unemployment rates for each of the two regions, ignoring occupational differences. The overall unemployment rate in region 1 is 60/400 = 15 per cent, while in region 2 it is 66/400 = 16.5 per cent. The question to be answered is whether the difference is attributable to structure or to behaviour.

$$UR_1^C = \frac{200}{200+200} * 15 + \frac{200}{200+200} * 15 = 15,$$

$$UT_2^C = \frac{200}{200+200} * 15 + \frac{200}{200+200} * 18 = 16.5. \qquad \text{(A.1)}$$

If we were to calculate the corrected unemployment rate from an industrial breakdown alone, we would conclude that the influence of structure was nil. By construction, the industry labour-force shares in each region are the same.

Table A-1

Labour Force Distribution by Industry, Occupation, and Region

	Region 1		Region 2	
	Industry *a*	Industry *b*	Industry *a*	Industry *b*
Occupation *x*				
U	15	10	15	4
N	100	100	100	40
UR_{ij}	15	10	15	10
Occupation *y*				
U_{ij}	15	20	15	32
N_{ij}	100	100	100	160
UR_{ij}	15	20	15	20
Total				
U_i	30	30	30	36
N_i	200	200	200	200
UR_i	15	15	15	18

It follows from equation 2 that the structurally corrected unemployment rate will be the same as the observed unemployment rate in each region. This, in turn, would seem to imply that none of the differences in regional unemployment rates could be attributed to differences in industrial structure.

Such a conclusion is, however, erroneous and arises because the two industries are not homogenous. Industry *b* uses more individuals in occupation y in region 2 than does the same industry in region 1. In this instance, unemployment probabilities are simultaneously determined by occupation and industry. The failure to account for this fact results in a mis-specification of the structurally corrected unemployment equation and biased estimates of the structurally corrected unemployment rate.[8]

Equation A-2 presents the corrected unemployment rates, assuming the same distribution of occupations and industries in region 2 as in region 1. In this case, the influence of structure is clear. The corrected unemployment rates in both regions are the same, reflecting the fact that occupation/industry unemployment rates are identical in both regions. The only difference between regions is the distribution of occupations within industry *b*, which in region 1 is biased towards the higher-risk occupation y. The occupational/industry-corrected unemployment rate correctly attributes all of the interregional difference in unemployment rates to differences in economic structure.

$$UR_1^C = \frac{100}{100+100+100+100} \times 15 + \frac{100}{100+100+100+100} \times 10$$

$$+ \frac{100}{100+100+100+100} \times 15 + \frac{100}{100+100+100+100} \times 20$$

$$= 15,$$

$$UT_2^C = \frac{100}{100+100+100+100} \times 15 + \frac{100}{100+100+100+100} \times 10$$

$$+ \frac{100}{100+100+100+100} \times 15 + \frac{100}{100+100+100+100} \times 20$$

$$= 15. \qquad \text{(A.2)}$$

The failure to simultaneously control for all structural differences yields biased estimates of the impact of economic structure. It would appear that previous efforts at measuring the impact of economic structure suffered from such aggregation bias. Perry. Hall, and Summers, among others, have attempted to measure the influence of differences in economic structure on unemployment both over time and across regions. The definition of structure

Table A-2

Provincial Unemployment Rates,[1] 1981

	Unemployment rate	Corrected	Difference
Age/sex decomposition			
Newfoundland	20.22	19.79	0.43
Nova Scotia	13.72	13.69	0.03
New Brunswick	17.92	17.64	0.28
Quebec	13.59	13.87	–0.28
Ontario	8.31	8.31	–
Manitoba	7.98	7.90	0.08
Saskatchewan	6.11	6.23	–0.12
Alberta	5.37	5.20	0.17
British Columbia	9.02	9.06	–0.04
Canada	10.03	10.07	–0.04
Industrial decomposition			
Newfoundland	20.22	18.89	1.33
Nova Scotia	13.72	13.17	0.55
New Brunswick	17.92	15.63	2.29
Quebec	13.59	11.76	1.83
Ontario	8.31	8.31	–
Manitoba	7.98	8.68	–0.70
Saskatchewan	6.11	6.93	–0.82
Alberta	5.37	6.50	–1.13
British Columbia	9.02	8.94	–0.08
Canada	10.03	9.63	0.40
Occupational decomposition			
Newfoundland	20.22	16.49	3.73
Nova Scotia	13.72	12.56	1.16
New Brunswick	17.92	14.82	3.10
Quebec	13.59	11.60	1.99
Ontario	8.31	8.31	–
Manitoba	7.98	8.48	–0.50
Saskatchewan	6.11	6.80	–0.69
Alberta	5.37	6.38	–1.01
British Columbia	9.02	8.83	0.19
Canada	10.03	9.45	0.58

1 Corrected for differences in the distribution of: demographic characteristics, industry, and occupation.

employed in those three studies varies both between and within them. Perry [1970] calculated an unemployment rate for the United States that controlled for changes in the age/sex composition of the labour force. Hall [1970] attempted to control for the effects of race, age, sex, marital status, and family

size, *inter alia*, in explaining intercity unemployment rates differentials. More recently, Summers [1986] followed up Hall's work attempting to control for age, sex, marital status, industrial structure, educational status, and industrial structure.

The methodology and logic pursued in each of these studies are directly related to the discussion in the first section of the present work (see equations 1 to 3.) The studies differ only in the definition of subsectors, demographic categories across time [Perry], or industrial structure either across regions [Hall and Summers] or across time [Perry].

Neither Hall, Perry, or Summers were able to find quantitatively significant structural impacts. Intuitively and theoretically, these results were disappointing. Widely available technology, mobile capital and labour, and a relatively competitive economy all argue for an equalization of sectoral factor-utilisation rates across regions. If regional unemployment-rate differentials are not a result of differences in economic structure, then they must derive from forces that have effectively isolated regional economies from the forces of equilibration. No one denies the existence of such forces. It is difficult, however, to accept that they explain nearly all of the difference in regional unemployment rates and that virtually none of it can be explained by structure.

In Canada, where regional differences are even more pronounced than in the United States, one would expect a greater role to have been played by structure. Table A-2 reports corrected unemployment rates, calculated following the methodology used by Summers, Perry, and Hall, and using data from the 1981 census. As was the case in the U.S. studies, very little of the variation in regional unemployment rates is explained by the age/sex composition of the labour force, its industrial makeup, or its occupational composition.

The extent of the aggregation bias implicit in this approach is evident when these corrected unemployment rates are compared with those of Table 3.

Notes

1 The intertemporal equivalent of equation 2 considers only one economy j and holds sectoral unemployment rates constant at their values in some base year. The structurally corrected unemployment rate is then calculated as the rate of unemployment that would have been observed if sectoral unemployment rates were the same as in the base year while labour-force shares followed their historical progression. For an example of this kind of calculation, see Burns [1990].

2 For those who are used to thinking of structural unemployment in the traditional Keynesian sense, this line of thought may be discomforting. It need not be. The measure of structural unemployment developed in this paper is a general concept that includes as a special case the Keynesian notion of a noncyclical rate of unemployment due to frictional and compositional characteristics of a particular economic structure. When aggregate demand is notional – i.e., when there is neither excess nor insufficient aggregate demand – ours and the Keynesian notions are the same.

3 Howitt and McAfee [1987] provide an interesting search-theory model that considers demand-deficient unemployment, search unemployment, and – if extended somewhat – different unemployment rates in different labour markets.

4 I would like to thank Professor Greene for the invaluable support he provided. The size of the problem undertaken here pushed his program well beyond its design limits and, on more than one occasion, Professor Greene cheerfully provided a patch permitting the analysis to continue.

5 Amemiya [1981, pp. 1502-7] discusses various means by which qualitative dependent-variable models may be evaluated. The relative severity of the proportion of unemployed correctly predicted as opposed to the proportion of labour-force statuses correctly predicted is indicated by the fact that our model correctly predicted 98.5 per cent of all individual labour-force status in 1971 for the Atlantic region, while only 25.4 per cent of the unemployed were correctly identified. Such discrepancies are common in binary models where the majority of observations fall within one category.

6 Using the canning and auto-parts industries (both manufacturing industries in our industry breakdown) as examples, it may be that the unemployment probability associated with each of the two is the same in all provinces, but if the unemployment probability in the canning industry is different from that of the auto-parts industry and if the proportions of canning and auto-part workers differ from province to province, then the

average unemployment probability of the manufacturing sector will also differ across provinces. That average difference will be reflected in different estimated coefficients.

7 In so far as these differences serve to make one industry or sector different from another, their effect on estimated coefficients is analytically identical to aggregation bias. In this case, it is the quality of the resource or the climate that distinguishes between industries. Within industry group A, there are two subsectors comprised of firms endowed with rich and poor resources, respectively. Obviously, if one were to follow a reductionist line of reasoning, all differences could be attributed to structure, assuming it were defined with sufficient precision. The dividing line between structural effects and behavioural effects will always be arbitrary to a certain extent. Where we draw the line between structure and behaviour will depend on the available data and on pragmatic considerations such as the usefulness of further disaggregation. In our case, the data have been the limiting factor.

8 The mis-specification arises from the fact that equation 4 above incorrectly assumes that the probability of unemployment within an industry is independent of occupation. The bias arises from the fact that the expected rate of unemployment for all individuals within an industry is incorrectly estimated to be 0.18 whereas it is, in fact, 0.10 for those in occupation x and 0.20 for those in occupation y.

References

Amemiya, Takeshi [1981]. "Qualitative response models: a survey." *Journal of Economic Literature* 19:1483-1536.

Blanchard, O. J., and L. H. Summers [1986]. "Hysteresis and the European unemployment problem." *NBER Macroeconomics Annual* 1:15-89.

Brooks, Clive, and Paul A. Volker [1983]. "Labour market success and failure: an analysis of the factors leading to the workforce destinations of the Australian population." In *The Structure and Duration of Unemployment in Australia*, ed. Paul A. Volker. Monograph no. 6, Bureau of Labour Market and Research. Canberra: Australian Government Publishing Service.

Burns, Andrew R. [1990]. "The natural rate of unemployment: a regionally disaggregated approach." Working paper no. 2. Economic Council of Canada, Ottawa.

_____ [1991]. "Unemployment in Canada, 1971, 1981, 1986: a breakdown of unemployment probabilities by sector and individual characteristics." A paper prepared for the Economic Council of Canada, Ottawa.

Drewes, T. [1987]. "Regional wage spillover in Canada." *Review of Economics and Statistics* 69:224-31.

Greene, William [1988]. *LIMDEP: Version 5 User's Manual*. Department of Economics, School of Business. New York: New York University.

Hall, Robert E. [1970]. "Why is the unemployment rate so high near full employment?" *Brookings Papers on Economic Activity*, no. 3:369-402.

Heckman, James J., and Thomas E. MaCurdy [1986]. "Labour econometrics." In *Handbook of Econometrics*, ed. Z. Griliches and M. D. Intriligator. Amsterdam: Elsevier Science Publishers.

Howitt, Peter, and Preston McAfee [1987]. "Costly search and recruiting." *International Economic Review* 28:89-107.

Inglis, P. A., and P. A. Volker [1983]. "Unemployment in Australia: an overview of some of the issues." In *The Structure and Duration of Unemployment in Australia*, ed. Paul A. Volker. Monograph no. 6, Bureau of Labour Market and Research. Canberra: Australian Government Publishing Service.

Inglis, Paul A., and Thorsten Stromback [1986]. "Migrants' unemployment: the determinants of employment success." *The Economic Record* 62: 310-24.

Keynes, J. M. [1936]. *The General Theory of Employment, Interest and Money*. Reprint, 1978. Cambridge: Cambridge University Press, for the Royal Economic Society.

Lilien, D. M. [1982]. "Sectoral shifts and cyclical unemployment." *Journal of Political Economy* 90:777-93.

Perry, George L. [1970]. "Changing labor markets and inflation." *Brookings Papers on Economic Activity*, no. 3:411-41.

Statistics Canada [1975]. *1971 Public Use SAMPLE TAPES User Documentation*. Ottawa: Statistics Canada, March.

_____ [n.d.]. "1981 Census of Canada public use sample tapes: user documentation." Statistics Canada, Ottawa.

_____ [1989]. "1986 Census public use microdata file on individuals documentation and user's guide (preliminary edition)." Statistics Canada, Ottawa, November.

Summers, Lawrence H. [1986]. "Why is the unemployment rate so very high near full employment?" *Brookings Papers on Economic Activity*, no. 2: 339-96.